Fermilab

Memorandum

Date: May 29, 2014

To: AD Radiation Safety Files

From: Joel Fulgham

Subject: Dose measurements around the NM3 target pile

***Executive Summary* – Currently Sea Quest is limited in beam intensity by dose rates going into the parking lot on the north end of the building. In an attempt to find weak points in the shielding an array of luxel badges were installed and normal beam operations were conducted for 6 days. A weak point in the target pile shielding was found on the east side, based on the vertical array dosimetry badge readings, however the highest dose rates are contained within the NM4 hall, and the north parking lot has been roped off and posted as a Controlled Area for the low dose rates (<5 mrem/hr) possible at maximum intensity.**

I. The setup

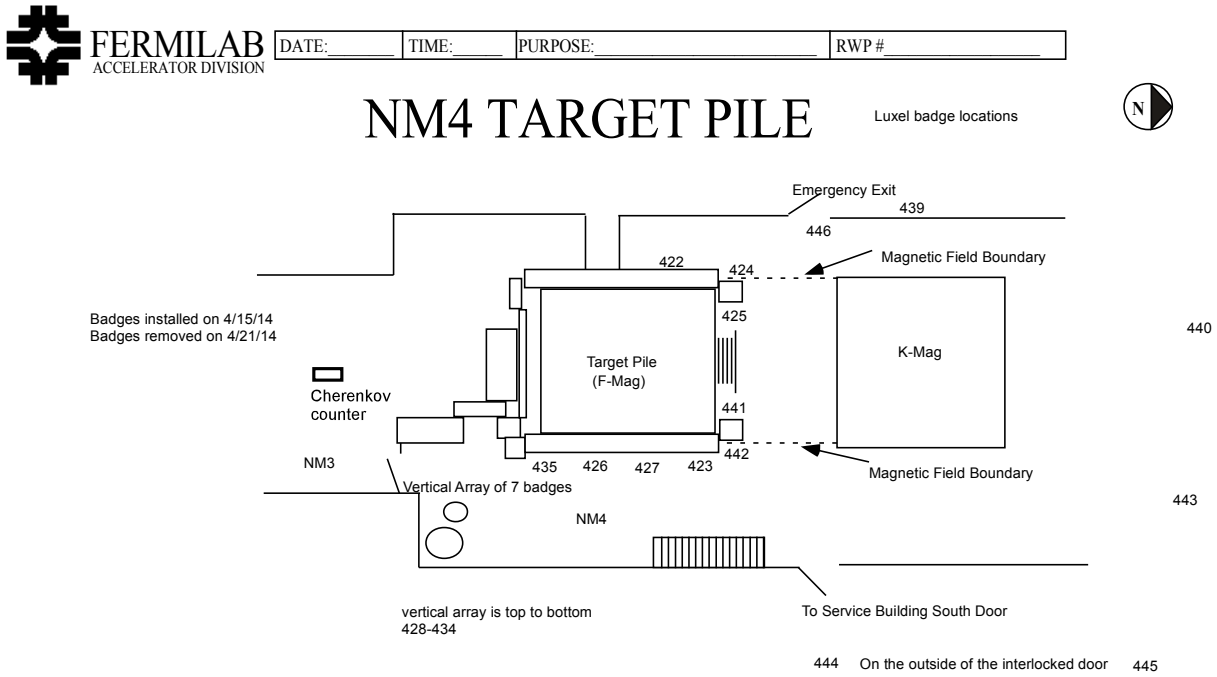

Figure 1. Location of each badge.

The badges around the target pile are at beam elevation. The badges for the vertical array were set with badge 431 at beam elevation. Then badges were placed every 2 feet up and down from the middle for a total of 6 feet above and below beam elevation. All badges were oriented with their face towards the radiation field.

2 Measurements.

Normal beam operation continued from approximately 1100 on the 15th to 0715 on the 21st. Average beam intensity was approximately 2.3E12 ppp.

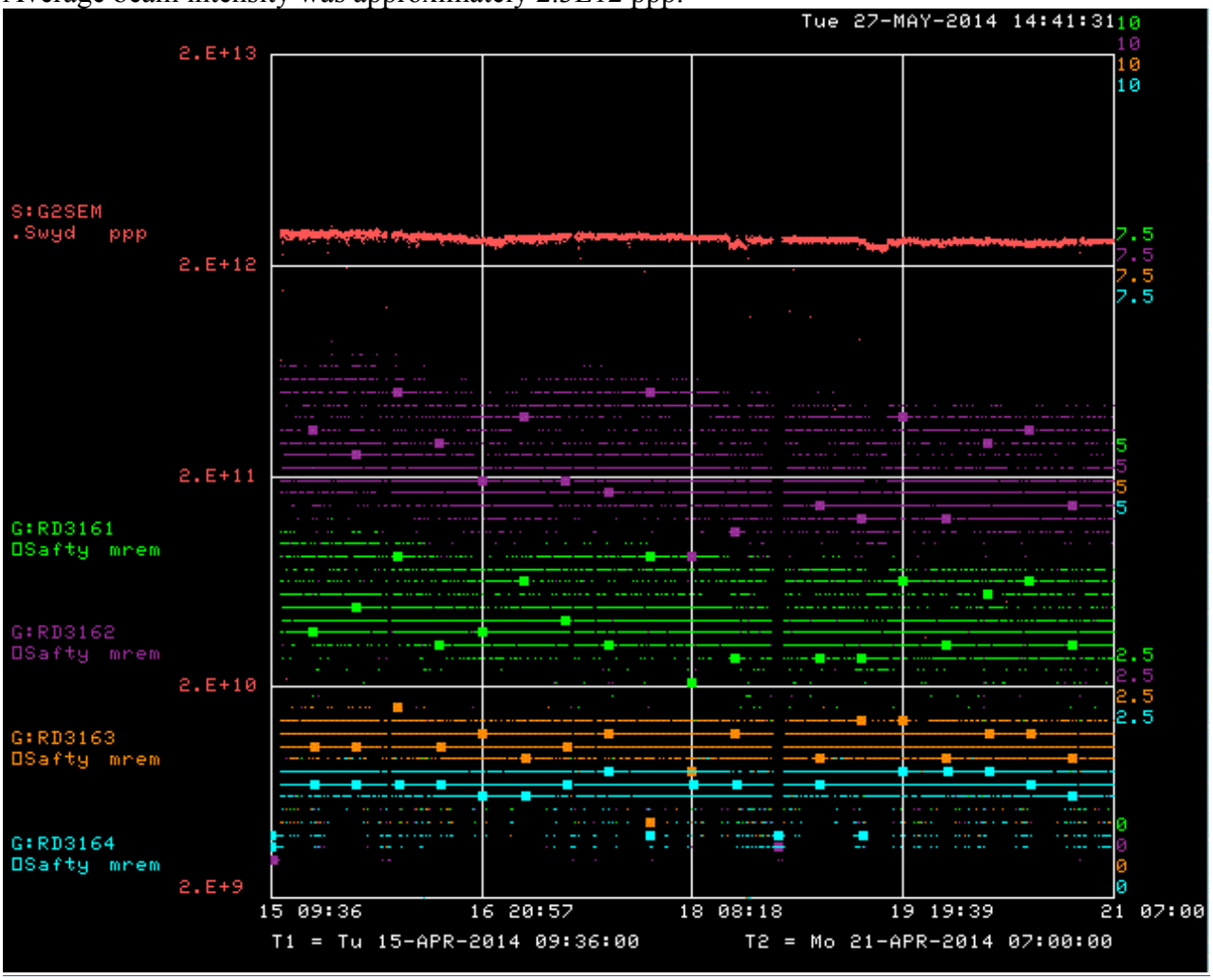

Figure 2. The beam intensity on the G2SEM for the week and nearby chipmunk detectors.

The results.

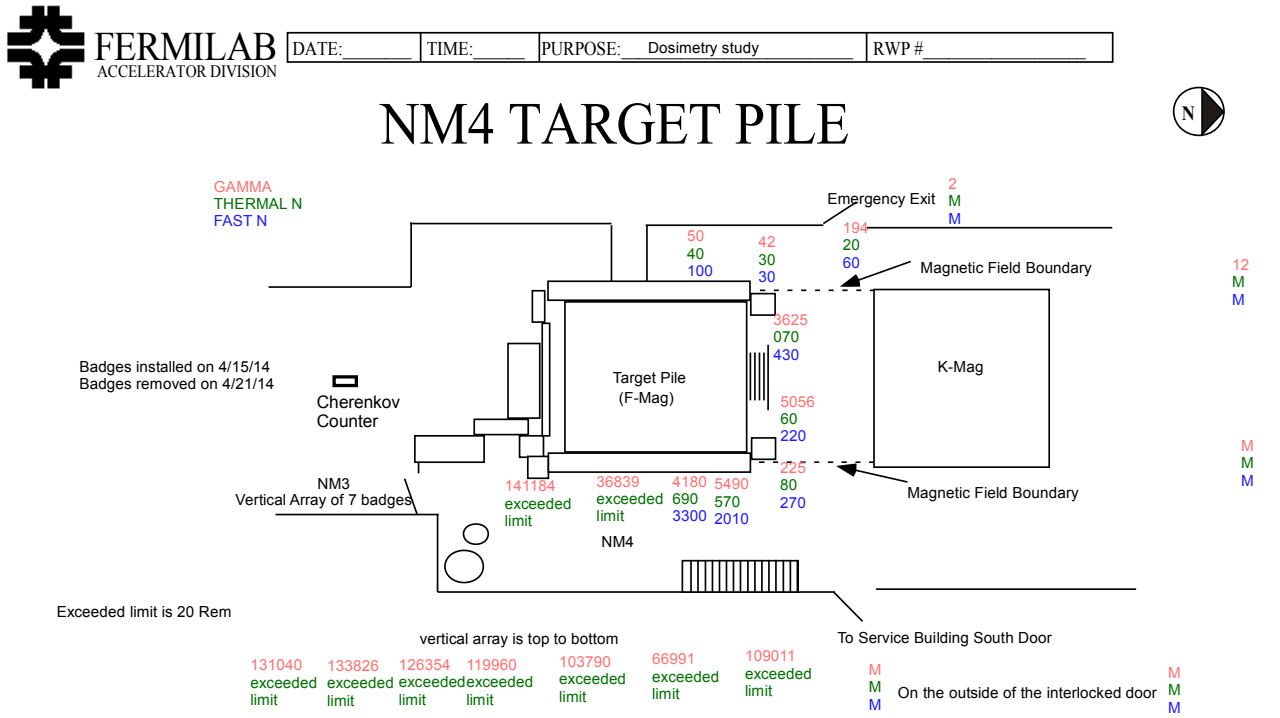

Figure 3. Badge reading in place of the badge numbers for ease of analysis.

3 Analysis.

a. Anomalous Readings

All the badges in the vertical array and the next 2 badges going north on the east side of the target pile exceeded the limit of 20 rem. The second badge from the bottom, badge 433, had a gamma reading of about half the other badges in the array.

b. Error in badge placement.

Badges 440 and 443 were placed on the outside of the north wall of the building and about 2 feet above the ground. This location caused them to be shielded by the concrete loading dock. Therefore are not useful for analyzing doses in the north parking lot.

c. East side of target pile

The shielding arrangement on the east side of the target pile and around the gate allows a path for a high gamma and neutron flux to pass by the shielding and thus is allowing higher than desired dose rates in the north parking lot. The actual control room in the building is shielded by an additional 8 feet of dirt and concrete. It is also protected by interlocked chipmunks and monitored with an area badge. The following pictures are of the shielding to the east side of the target pile from the location of the Cherenkov counter.

Picture 1. Looking at the NM3/NM4 gate.

Picture 2. Target pile and east side hand stacked blocks.

4. Summary

Though the neutron portions of the badges on the east side of the target pile were reporting "Exceeding Limit", they demonstrated that this region is the weakest portion of the shielding. To be allowed to run at a higher intensity shielding configuration should be addressed. Or the parking lot to the north side of the building, directly downstream of the target hall, needs to be fenced off and posted as a radiation area.